

The final exam will consist of questions from the following units:

Mole Conversions and Stoichiometry, States of Matter (KMT), Behavior of Gases, Solutions, Acids and Redox Reactions

Mole Conversions and Stoichiometry:

- Determine the number of liters in 1 mole of any gas at STP
 - 22.4 L @STP
- Determine the number of items in 1 mole of any substance
 - 6.02×10^{23}
- Determine the number of grams in 1 mole of any substance
 - Elements = atomic weight
 - Compounds = molar mass or molecular weight
- This section will be tested on the free response (problems) part
- Complete percent yield calculations.

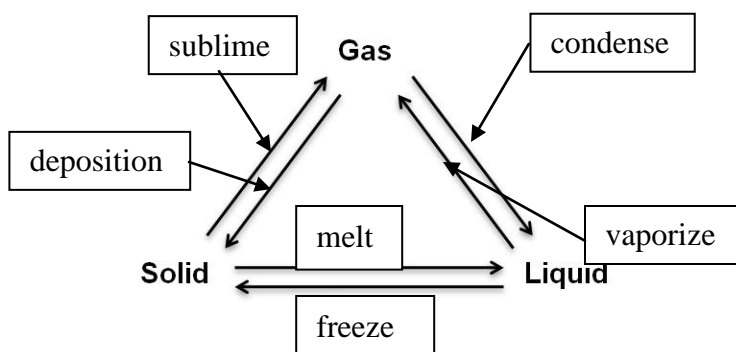
States of Matter:

- Describe the points of the Kinetic Molecular Theory and how they relate to solids, liquids, and gases
 - All matter is made of tiny particles
 - All particles are in constant motion. The higher the temperature of the substance, the faster the particles move.
 - All energy is conserved. When particles collide, no energy is lost
 - At the same time temperature, more massive (heavier) particles move slower than less massive (lighter) particles.
- Identify all six phase changes and describe what is happening during each change in terms of heat and energy of particles
 - Solid to liquid: melting, more energy,
 - Liquid to solid: freezing, less energy
 - Liquid to gas: evaporation, more energy
 - Gas to liquid: condensation, less energy
 - Gas to solid: deposition, less energy
 - Solid to gas: sublimation, more energy
- Compare and contrast the four types of intermolecular forces (IMF's) in terms of strength and where they are found
 - Ionic bonds > H bonding > Van der Waals dipole-dipole interactions > Van der Waals dispersion forces.

- Complete the following table

	Solid	Liquid	Gas
Definite volume? (Y/N)	YES	YES	NO
Fluid? (Y/N)	NO	YES	YES
Compressible? (Y/N)	NO	NO	YES
Attractive forces between molecules (strong/medium/none)	STRONG	MEDIUM	NONE
Speed of molecules	SLOW	MODERATE	FAST

- Water boils at 100 °C while methane (CH₄) boils at -161 °C. Both have similar masses. Explain using KMT why water boils at a higher temperature.
 - Hydrogen bonding
- Where will water boil at a higher temperature – Mount Everest or New Orleans? Explain. New Orleans-greater atmospheric pressure
- Label the following diagram:



- Determine the relationship between atmospheric pressure and boiling point
- Define equilibrium, explain under what conditions can it exist, and the processes that are taking place when it does exist
 - Can exist in a number of conditions. Two opposing processes such as dissolving and recrystallizing happen at the same rate
- What does the term dynamic equilibrium mean?
 - Means that is active
- Which system is at dynamic equilibrium – a closed water bottle or an open one?
 - Closed water bottle

Gases and Their Properties:

- Define STP is 273 K or 0° C and 760 mmHg or 1 atm
- Convert between degree Celsius and Kelvin: $K = 273 + ^\circ\text{C}$
- Solve all gas law problems (Boyle, Charles, Guy-Lussac, Combined, Ideal)
 - See problem section of this review

Solutions:

- Define solute and solvent and differentiate between the two
 - 1. Solute which is the substance being “dissolved”
 - 2. Solvent which is the substance doing the dissolving.
 - 3. The substance in greatest percentage is usually considered to be the solvent.
- ~~• Determine which substances will dissolve the fastest (or slowest)~~
- Describe the various ways to increase the dissolution of a solid in water
 - 1. By stirring the solution (increase dispersion of solute)
 - 2. By powdering the solid (increases surface area)
 - 3. By heating the solvent (increases particle activity)
 -
- Describe the relationship between temperature and the solubility of gases in water
 - The solubility of a gas decreases as the temperature of the solvent increases.
- Describe the relationship between temperature and the solubility of solids in water.
 - Generally, increasing the temperature increases the solubility of solids in liquids.
 - Another way to say this is increasing temperature increases concentration
- Differentiate between an electrolyte and non-electrolyte solution
 - Substances that can dissolve in water and the solution **can** conduct electricity are called *electrolytes*.
 - Substances that can dissolve in water and the solution **cannot** conduct electricity are called *nonelectrolytes*
- Determine what substances will dissolve in each other (relate to terms of polarity)
 - A General rule applied to solute-solvent relationships goes like this: “ Like dissolves like”
 - There are two types of solutes and solvents.
 - They are polar and nonpolar.
- Calculate the following: see problem section
 - Molarity
 - Molality
 - Weight by percent

- Answer questions using a solubility chart. See problem section
- Describe how certain solutes will affect the freezing and boiling points of a solvent.
- Colligative properties depend only on the number of dissolved particles in solution and not on their identity.
 - Freezing point depression of the solvent
 - Boiling point elevation of the solvent
- Calculate the freezing and boiling points of solutions
 - See problem practice section

Acids and Bases:

- List the properties of acids and bases
- Acids
 - sour taste
 - contain the element hydrogen
 - some will react with metals to produce hydrogen gas
 - change the colors of acid-base indicators
 - will react with bases to form a salt and water
- Bases
 - bases have a bitter taste
 - dilute solutions feel slippery to the touch
 - will change the color of a acid-base indicator
 - bases react with acids to produce a salt and water
 - will destroy animal tissue
- Describe Arrhenius acids and bases
 - Acid-a chemical compound that contains hydrogen and ionizes in aqueous solution to form hydrogen ions
 - Base-a substance that contains hydroxide ions and dissociates to produce hydroxide ions in water
 - said to be alkaline
- Describe Brønsted-Lowry acids and bases
 - Acid-any ion or molecule that can donate a proton such as water
 - Base-any molecule or ion that is a proton acceptor
- Differentiate between conjugate acid and conjugate base
 - A conjugate base is:
 - what remains of an ion or molecule after it has donated a proton
 - and the ion or molecule may now accept a proton
 - A conjugate acid is:
 - what remains after an ion or molecule has accepted a proton
 - and can now donate a proton
- Determine the conjugate acid-base pairs in a chemical reaction See practice problems

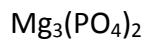
- ~~List the six strong acids and seven strong bases (both names and formulas)~~
- ~~Differentiate between monoprotic, diprotic, and triprotic~~
- Calculate pH, pOH, $[H^+]$, and $[OH^-]$ using the given equations: see problem practice section
- Determine if a substance is acidic or basic based on its respective pH, pOH, $[H^+]$, or $[OH^-]$
 - 0-6.999 is acidic 7.001 -14.000 is basic or alkaline
- Describe how the pH scale compares the acidity of any two substances, given their respective pH values
- Determine the products of a neutralization reaction, and solve titration problems
 - acid + base \longrightarrow a salt + H_2O
- How can you identify an Arrhenius acid from its formula? An Arrhenius base?
 - Formulas for acids start with H
 - Formulas for bases will have OH

Redox Reactions:

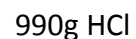
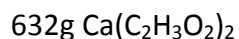
- Assign correct oxidation numbers (charges) using the rules
- Define oxidation and reduction
 - Oxidation is the loss of e^- ; ox # increases
 - Reduction is the gain of e^- ; ox # decreases
- Identify the oxidation and reduction half reactions
 - Use OILRIG
- In a reaction, the
 - Oxidizing agent** gets **reduced**.
 - The **reducing agent** gets **oxidized**.

Practice Problems

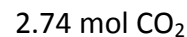
1. Determine the molar mass of the following compounds:



2. Determine the number of moles in each of the following:

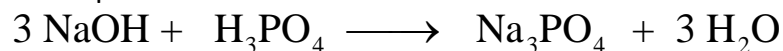


3. Determine the number of representative particles in the following:

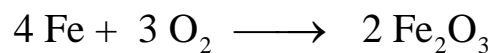


4. Calculate the mass of NaOH is needed to react with 196g of H_3PO_4 in order to produce water and sodium phosphate according to the following **unbalanced** reaction:

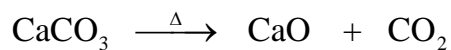
1st balance the equation



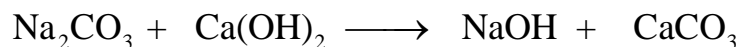
5. Calculate the mass of O_2 that is needed to react with 117 g Fe to make iron (III) oxide?



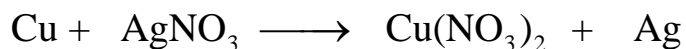
6. Calcium carbonate, CaCO_3 , decomposes and produces 2.26g calcium oxide, CaO . If the theoretical yield is 2.68g, what is the percent yield?



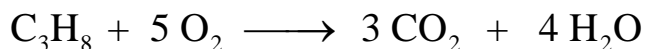
7. Calculate the mass of NaOH produced when 254 grams of Na_2CO_3 are reacted according to the following **unbalanced** reaction:



8. Calculate the mass of Cu needed to produce 2.25 g Ag according to the following **unbalanced** reaction:



9. Calculate the volume of oxygen gas needed to produce 6.5 Liters of CO_2 according to the following reaction:



10. For the following pairs, circle the one in which particles are moving the fastest:

- a. A liquid at 50 °C or A liquid at 100 °C
- b. A solid at 50 °C or A liquid at 50 °C
- c. A solid at 100 °C or A gas at 50 °C
- d. He gas at 30 °C or Kr gas at 30 °C

11. Why is the Kelvin temperature scale more appropriate than the Celcius or Farenheit scales when thinking about KMT?

12. What are STP conditions?

13. The initial temperature of a gas is 43°C. Calculate the final temperature if the volume changes from 500mL to 350mL at constant pressure?

14. Calculate the original volume of a gas at -10°C if the final volume of gas is 200 gallons at 25°C and pressure is held constant?

15. Calculate the final pressure on a balloon if its volume changes from 250 ft³ at 770 mm Hg to 1000 ft³ with constant temperature?

16. A rigid vessel of gas at STP is heated to 900°C. Calculate the new pressure.

17. Underline the solvent in each of the following solutions

- a. A solution containing 10.0 g of glucose ($C_6H_{12}O_6$) and 500.0 g of water
- b. A solution containing 60.0 mL of ethyl alcohol and 30.0 mL of methyl alcohol

18. Complete the following table using the combined gas law:

Parameter	Initial	Final
Temperature	23°C	58°C
Volume	360mL	150mL
Pressure	230 torr	?
Temperature	Standard	105°C
Volume	5L	?
Pressure	Standard	2 atm
Temperature	30°C	Standard
Volume	300mL	?
Pressure	795 mm Hg	Standard

19. Why does water not dissolve motor oil?

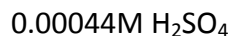
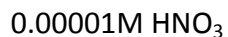
20. In which solution is the solubility of a gas higher – cold water or hot water?

21. What three things can you do to get sugar to dissolve faster in water?

22. When a solute is added to water, what happens to the freezing point? To the boiling point?

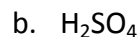
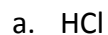
23. Which will freeze at a lower temperature – a 1.5 m solution of NaCl or a 1.5 m solution of MgCl_2 ?
24. Which will boil at a higher temperature – a 1.5 m solution of $\text{C}_6\text{H}_{12}\text{O}_6$ or a 1.5 m solution of NaCl?
25. Calculate the molarity of a solution if 236g of HI is dissolved in 17,500mL of solution?
26. Determine the mass of solute in 2000mL of a 0.25M solution of CuSO_4 .
27. Calculate the molarity of 114g $\text{Al}_2(\text{SO}_4)_3$ in 1500mL of solution.
28. Calculate the weight of KBr needed to make 200g of a 5% solution.
29. Calculate the mass of solute is needed to make 350mL of a 0.1M solution of $\text{C}_2\text{H}_5\text{OH}$.
30. Calculate the molality of a solution in which 115g AlCl_3 in 1500g water.
31. What would be the freezing point and boiling point of the solution in #18

32. Calculate the pH and pOH of the following solutions:

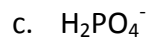
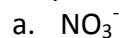


33. Calculate the pOH, hydronium ion, and hydroxide ion concentration for a solution with a pH of 5 and a solution with a pH of 12.35.

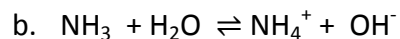
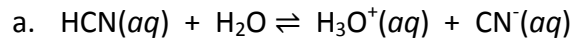
34. Identify the conjugate base for the following:



35. Identify the conjugate acid for the following



36. Label the acid, base, conjugate acid and conjugate base for the following:



37. During a titration process, 35mL of 2.0M H_2SO_4 neutralizes exactly 20.0mL of NaOH.

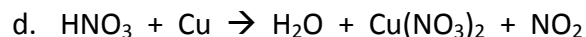
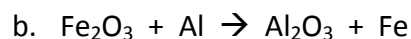
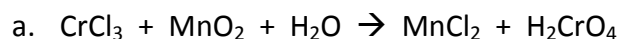
- Predict the products
- Balance the equation
- Label the acid, base and salt
- Name the salt
- Calculate molarity of the base solution.

38. Complete the following for the neutralization reaction between NaOH and HCl.

- Predict the products
- Balance the equation
- Label the acid, base and salt
- Name the salt
- If 15.2 mL of a 1.7 M NaOH solution are needed to neutralize 22 mL of HCl, what is the molarity of the HCl?

39. For the following equations:

- Assign oxidation numbers to all atoms
- Identify which element is oxidized and which is reduced



40. Use the solubility curve chart to answer the following:
- How many grams of $\text{Ce}_2(\text{SO}_4)_3$ will dissolve in 100 g H_2O at 10°C ?
 - How many grams of NaNO_3 will dissolve in 100 g H_2O at 60°C ?
 - How many grams of NH_3 will dissolve in 100 g H_2O at 90°C ?
 - Identify the following solutions as saturated, unsaturated or supersaturated:
 - A solution of KClO_3 at 40°C contains 45 g in 100 g H_2O .
 - A solution of NH_4Cl at 40°C contains 45 g in 100 g H_2O .
 - A solution of KNO_3 at 40°C contains 45 g in 100 g H_2O .
 - How many grams of KNO_3 can be added to 100 g of H_2O if the temperature is increased from 0°C to 60°C ?
 - How many grams of KCl will precipitate out of 100 g of water that is cooled from 80°C to 20°C ?

